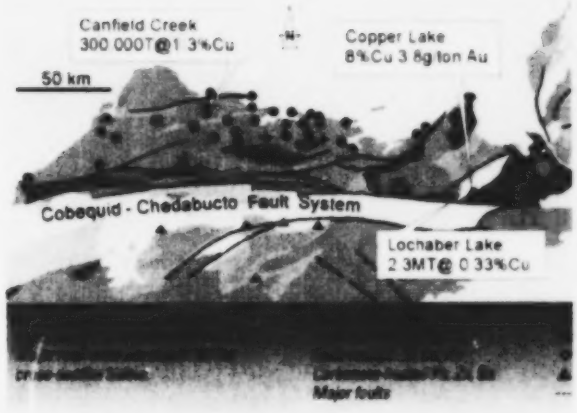
Copper Deposits in the Carboniferous Rocks of Northern Nova Scotia

R. J. Ryan

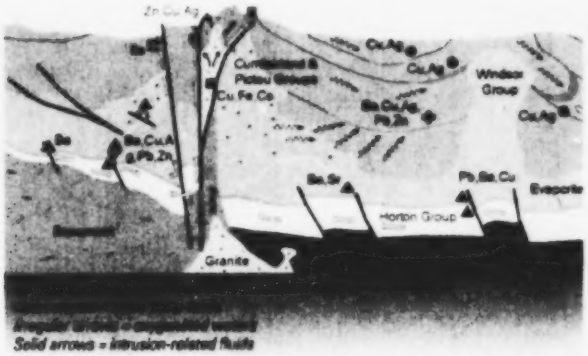
Copper deposits hosted by the Carboniferous rocks of northern Nova Scotia can be divided into two genetic affinities: (1) redbed copper deposits hosted by shale or sandstone, and (2) fault-related deposits.



Redbed Deposits

Numerous redbed copper occurrences are characterized by chalcocite, digenite and bornite associated with minor amounts of native silver, pyrite, barite, sphalerite and galena. Host rocks are grey carbon-rich sandstone and shale, usually of Late Carboniferous age. The textures, paragenesis of minerals, and thermal indicators (R_o and fission tracks) suggest low-temperature mineralization (<100°C). Mineralization was closely associated with red/grey (redox) boundaries in the strata suggesting a link between mineralization and reddening. Reddening of sandstones adjacent to the deposits is secondary and paleomagnetic studies have suggested that the reddening and mineralizing event took place in the Late Permian. This corresponds to a basin-wide exhumation event postulated from thermochronological studies of the Maritimes Basin.

Both the shale- and sandstone-hosted redbed deposits probably resulted from leaching of chalcophile elements in the sandstone and conglomerate during reddening, and their subsequent transport to sites where fluid interaction with organic- and pyrite-rich beds resulted in re-precipitation of the copper and associated metals. Shale-hosted deposits occur in grey shales overlying red conglomerate and sandstone. These deposits are probably terrestrial equivalents of the Kupferschiefer type deposits of Europe and, therefore, have excellent potential to be traced laterally within the beds of the basin. Sandstone-hosted deposits are usually characterized as high-grade and low tonnage.



Energy Branch

Copper Deposits in the Carboniferous Rocks of Northern Nova Scotia

Nova Scotia

We're

North

Exploring

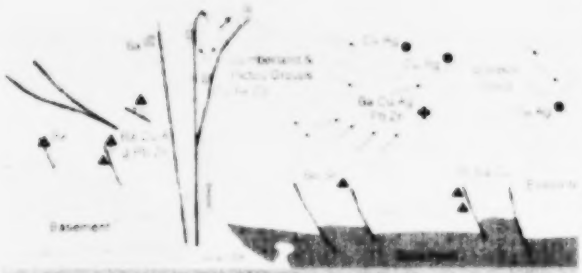
R. J. Ryan

Copper deposits hosted by the Carboniferous rocks of northern Nova Scotia can be divided into two genetic affinities: (1) redbed copper deposits hosted by shale or sandstone, and (2) fault-related deposits.

Distribution of significant copper occurrences in northern Nova Scotia. Major rock units are shown on the cross-section below.

Redbed sandstone-hosted Cu-Ag-Co
Shale-hosted Cu, Ag, Co
Fault-related Cu, Co, Au
Carbonate-hosted Pb, Zn, Ba
Major faults

Numerous redbed copper occurrences are characterized by chalcocite, digenite and bornite associated with minor amounts of native silver, pyrite, barite, sphalerite and galena. Host rocks are grey carbon-rich sandstone and shale, usually of Late Carboniferous age. The textures, paragenesis of minerals, and thermal indicators (R_o and fission tracks) suggest low-temperature mineralization (<100°C). Mineralization was closely associated with red/grey (redox) boundaries in the strata suggesting a link between mineralization and reddening. Reddening of sandstones adjacent to the deposits is secondary and paleomagnetic studies have suggested that the reddening and mineralizing event took place in the Late Permian. This corresponds to a basin-wide exhumation event postulated from thermochronological studies of the Maritimes Basin.

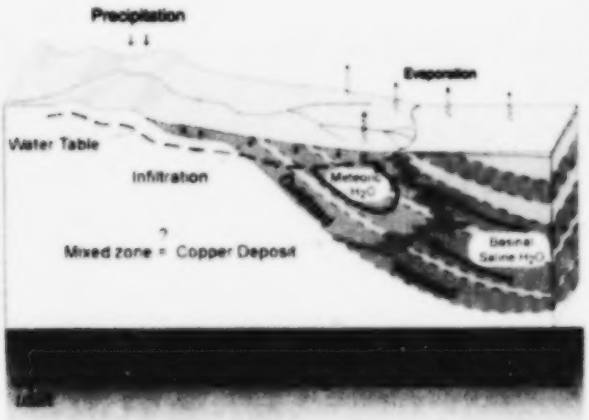


Conceptual model of Cu and Pb-Zn deposits in northern Nova Scotia. Open arrows = basin brine fluids. Irregular arrows = oxygenated waters.

Both the shale- and sandstone-hosted redbed deposits probably resulted from leaching of chalcophile elements in the sandstone and conglomerate during reddening, and their subsequent transport to sites where fluid interaction with organic- and pyrite-rich beds resulted in re-precipitation of the copper and associated metals. Shale-hosted deposits occur in grey shales overlying red conglomerate and sandstone. These deposits are probably terrestrial equivalents of the Kupferschiefer type deposits of Europe and, therefore, have excellent potential to be traced laterally within the beds of the basin. Sandstone-hosted deposits are usually characterized as high-grade and low tonnage.

Department of Natural Resources
Minerals and Energy

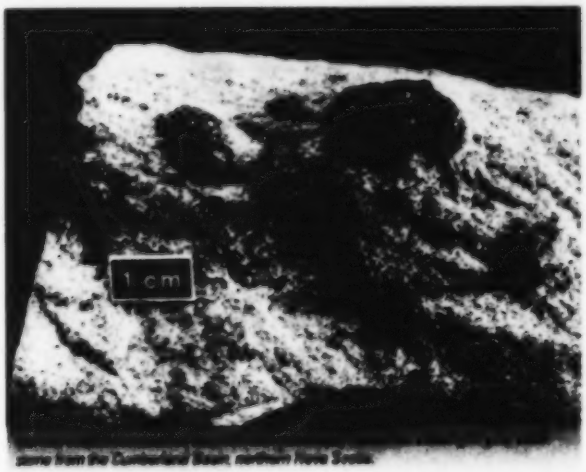
Information Circular
1996



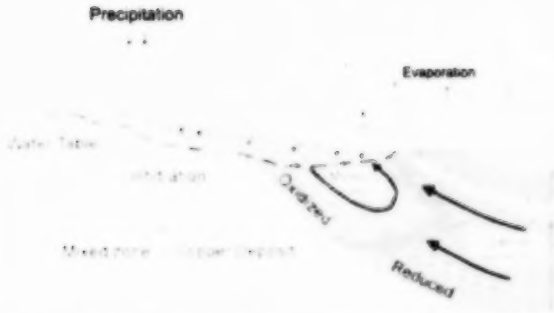
This solution front-redox type of mineralization is similar to the copper-silver deposits of the West Texas, Oklahoma (Paoli), and New Mexico (Nacimiento) areas. However, where oxidized mineralizing fluids mixed with reducing basin brines or hydrocarbons, giant deposits like those of the Dzhezkazgan area, Kazakhstan, could be expected. The similarity in age of strata, lithology of the host rocks, proximity to evaporite diapirs, mineralogy of the ore, sulphur isotope data, and structural setting between Dzhezkazgan and the occurrences of northern Nova Scotia is striking. This would strongly suggest that somewhere in the Carboniferous basins of Nova Scotia there may be deposits similar in scale to the Asian analogue.

Fault-related Vein Deposits

In addition to the redbed setting there are also many copper deposits along the Cobequid-Chedabucto Fault System. They are usually hosted by dark shale and limestone but are locally hosted by altered mafic igneous rocks. Many of these occurrences are associated with red beds of the Upper Carboniferous, although Carboniferous strata are not always present. The occurrences are characterized by chalcopyrite and bornite with associated siderite, ankerite, calcite, pyrite and barite. They are spatially related to faults and usually occur as vein stockworks. Temperature estimates indicate that these deposits formed at higher temperatures than the redbed type, with temperatures of greater than 150°C. Potential exists for higher-grade, large deposits with significant conc...ns of cobalt and gold. The timing of this mineralization is unknown and may be from Late Carboniferous to Jurassic. Mafic igneous activity along the fault system from Early Carboniferous to Late Triassic may have played a significant role in the mineralizing event. A model suggesting basin-wide expulsion of hot basin brines has been proposed to explain the lead-zinc occurrences in Lower Carboniferous carbonates. This expulsion event may have caused migration of hot fluid up the fault systems, resulting in, or contributing to, the copper deposits of the Cobequid-Chedabucto Fault System (see Information Circular 47).



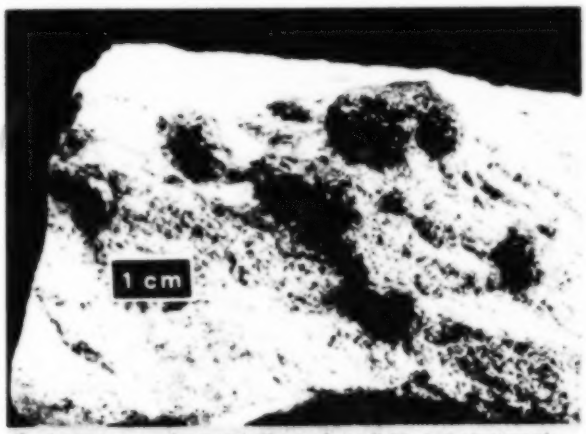
106-0 5750 /



Detailed model of possible interaction of metal-bearing, oxygenated meteoric water and updip-migrating, reducing basin brines. This should result in large-tonnage Cu deposits similar to those of the Dzhezkazgan region of Kazakhstan, formerly part of the USSR

This solution front-redox type of mineralization is similar to the copper-silver deposits of the West Texas, Oklahoma (Paoli), and New Mexico (Nacimiento) areas. However, where oxidized mineralizing fluids mixed with reducing basin brines or hydrocarbons, giant deposits like those of the Dzhezkazgan area, Kazakhstan, could be expected. The similarity in age of strata, lithology of the host rocks, proximity to evaporite diapirs, mineralogy of the ore, sulphur isotope data, and structural setting between Dzhezkazgan and the occurrences of northern Nova Scotia is striking. This would strongly suggest that somewhere in the Carboniferous basins of Nova Scotia there may be deposits similar in scale to the Asian analogue.

In addition to the redbed setting there are also many copper deposits along the Cobequid-Chedabucto Fault System. They are usually hosted by dark shale and limestone but are locally hosted by altered mafic igneous rocks. Many of these occurrences are associated with red beds of the Upper Carboniferous, although Carboniferous strata are not always present. The occurrences are characterized by chalcopyrite and bornite with associated siderite, ankerite, calcite, pyrite and barite. They are spatially related to faults and usually occur as vein stockworks. Temperature estimates indicate that these deposits formed at higher temperatures than the redbed type, with temperatures of greater than 150°C. Potential exists for higher-grade, large deposits with significant contents of cobalt and gold. The timing of this mineralization is unknown and may be from Late Carboniferous to Jurassic. Mafic igneous activity along the fault system from Early Carboniferous to Late Triassic may have played a significant role in the mineralizing event. A model suggesting basin-wide expulsion of hot basin brines has been proposed to explain the lead-zinc occurrences in Lower Carboniferous carbonates. This expulsion event may have caused migration of hot fluid up the fault systems, resulting in, or contributing to, the copper deposits of the Cobequid-Chedabucto Fault System (see Information Circular 47).



Bornite-chalcocite nodules covered with secondary malachite staining in grey basal sandstone from the Cumberland Basin, northern Nova Scotia

Department of Natural Resources
Minerals and Energy Branch

1701 Hollis Street
Halifax, Nova Scotia
Canada
B3J 2T9

For information contact:
John MacDonald
Phone: 902 424-2523
Fax: 902 424-7735
Email: macdonajh@gov.ns.ca